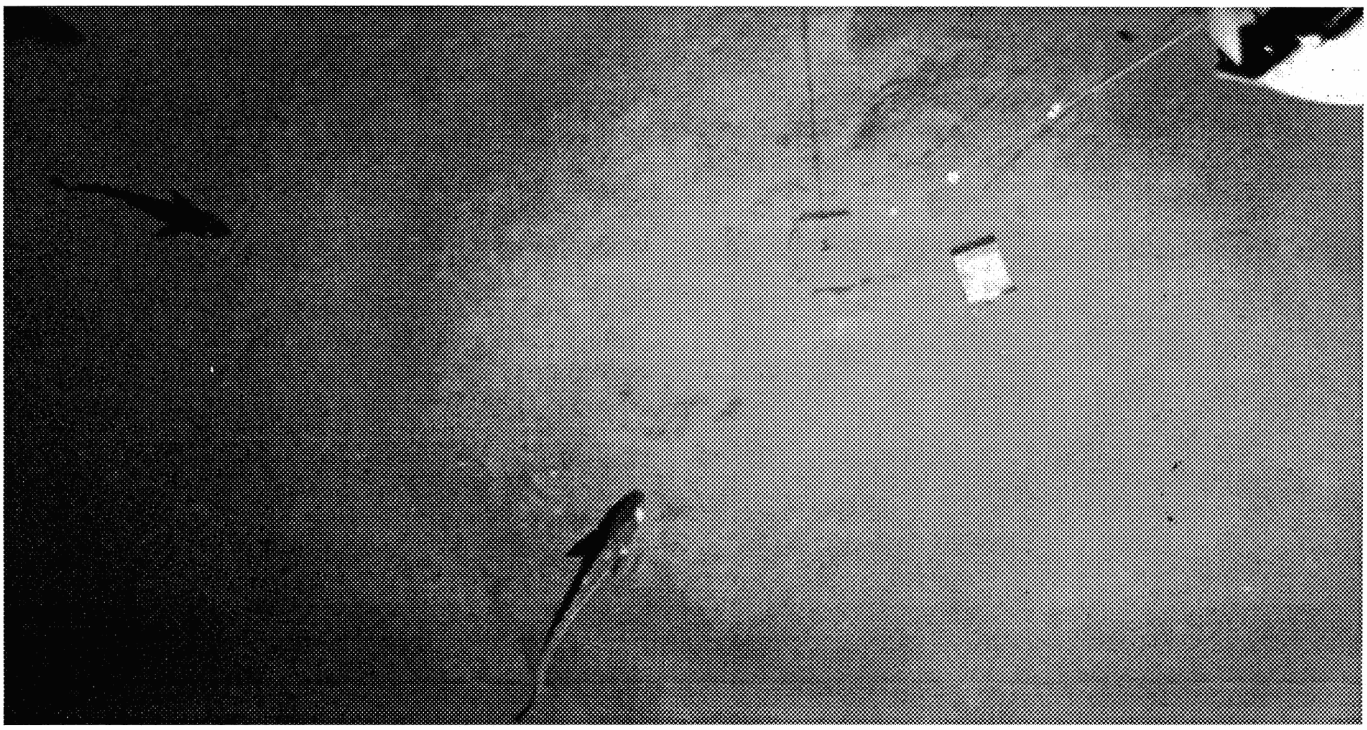
PyroTechnics 57

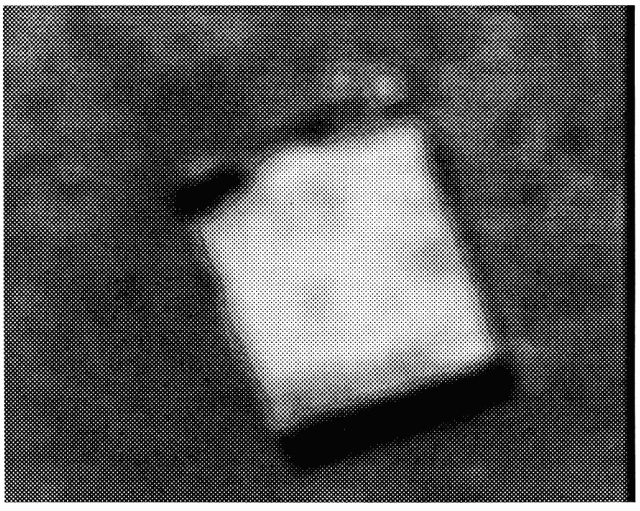
The now and then newsletter of General Technics. November 1997



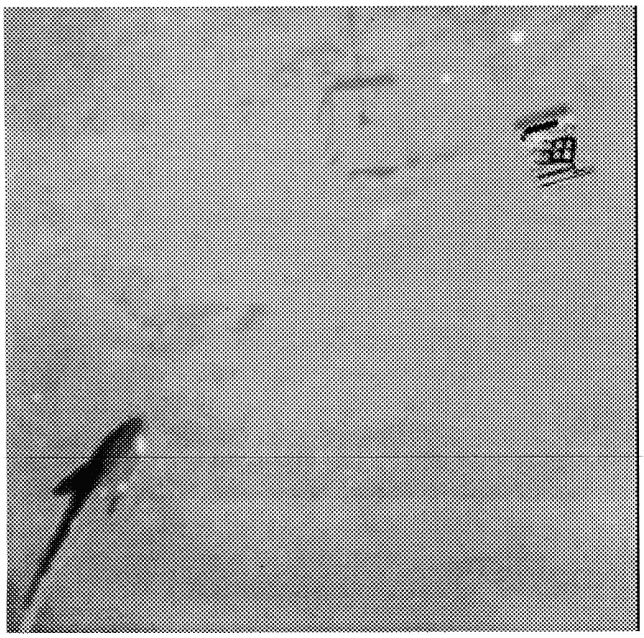
MicroSoggy Windows™

Barry Gehm

Last year, while some of us were attending the Worldcon in Scotland, Al Duester was out at sea, testing one of his seabottom-exploring robots (ABE, the Autonomous Benthic Explorer). The very first picture ABE took of the seafloor showed, in addition to the base of the target buoy and a couple of fish, a piece of junk that looked to be about the size and shape of a cereal box. Yes, the very first picture showed litter on the sea floor. No wonder Prince Namor was always so grouchy about "surface dwellers." Cap'n Al emailed the picture to Dermot and Perdy Dobson, at whose home in Oxford a number of GTers had congregated for a post-Worldcon party. In the original picture some vague and indistinct markings are just visible on the box. Using the powerful computer equipment in Dermot's home office, the crack GT Image Analysis Team were able to "enhance" the image and reveal the true nature of this piece of jetsam: a just-released upgrade to a widely-used piece of software. Naturally we emailed our results back to Cap'n Al.



At the following Capricon, Al gave a slide talk on his work at the Woods Hole Oceanographic Institute, ending with a slide of the enhanced image. In the darkness of the room, at least one audience member failed to notice that Al's tongue was in his cheek when he described the "enhancement" process, and soon the word went out over the Internet that a Windows 95 box had been found on the ocean floor only a few days after the product was released. Although the temptation to let the story go and see how far it would spread was strong, Al did the right thing and stepped in to set the record straight. The integrity of science was preserved, but Al lost his chance to become an urban legend in his own time.



NERD-TOPIA

Chuck Ott

Like most of us, I have a plan to take over America using computers. Unlike most, however, I'll be glad to share my plan with you. But before I reveal it, you must promise to use this secret knowledge only for good and never for evil.

Still with me?

Okay, then here is the esoteric understanding that will help you make sense of today's politics: this country started to go to hell about the time most of us no longer remembered who our precinct captain was.

A precinct, for those of you who thought the recent Republican and Democratic conventions represented something called "politics", is a small part of a city ward, usually just a couple of blocks. In Chicago, in the old days, you would always have a Democratic precinct captain, and may or may not have had a Republican precinct captain depending on whether there was more than one Republican family living there. (In a town with a Republican machine, such as Philadelphia used to have, it was the other way around.) The precinct captain always lived in his precinct, usually had a job with the city like truck driver or garbageman, and knew pretty much everybody in his flock by name. More to the point, he also knew the alderman personally.

You, Mr. or Mrs. J. Random Voter, did not know the alderman personally. You probably shook his hand once a year at a church picnic or something. You probably heard your Congressman speak at a rally once each election year, the precinct captain having leaned on you to attend. You might or might not have heard a speech from your senator once. But for all practical purposes, "the government" presented itself to you in three forms: (1) your tax bills, (2) cops, and (3) the precinct captain.

You got a traffic ticket? Your boy's been fired from the greengrocer's? You think the government ought to bomb Germany or stay the hell out of Germany? Your assessment's too high? The clerk at the drivers license bureau was rude? Who ya gonna call?

You're going to call your precinct captain, that's who. He says he knows somebody who can help you with the traffic ticket, and whether or not you actually get off, at least you feel as though you've been listened to. Your kid may or may not get a job with the Forestry department lopping trees over the boulevards, but at least you've got something to tell him. You can be assured the President will hear your message about Germany, because the President talks to your Congressman, who talks to the mayor, who talks to the aldermen, who listen to the precinct captains if they want to keep their jobs. Somebody will look at your assessment again, and that clerk is going to rue the day he was born because he sure didn't know who he was talking sass to!

And *that*, denizens of the Information Age, is real politics. We hardly have such a thing anymore.

To be sure, personal human contact still counts for a great deal in today's politics. Charm, as P.J. O'Rourke said, is still a requirement for office, and it is the business of professional politicians to have some. Bill Clinton is said to be a captivating companion and utterly likable fellow by those who know him personally, and all of the people who have worked directly with Bob Dole, in either party, are said to like and admire him, and apparently his jokes are a lot funnier in person as well. This kind of appeal is necessary to attract the core group of followers who will do the work of campaigning and administering.

To the extent that these characteristics come through the national media, or to the extent that we ascribe personal characteristics to a politician based on how we feel about his performance, millions of us feel that we have personal relationships with Clinton and Dole.

But in the Information Age, we mostly connect with the candidates through intellectual issues. We care about abortion, about tax cuts, about whether Clinton owes more favors to the trial lawyers than Dole owes to the Christian Coalition. The characteristic of these kinds of issues that you can fuss and obsess about them for months or years without ever experiencing a resolution. *Real* politics, on the other hand, comes to a decision: you either pay the ticket or don't, you get your pothole filled or you don't, you have confidence that the President hears you about issues because a person tells you so. Real politics creates stability and identification of citizens with the government. Our kind of politics is somewhat unstable and promotes a sense of frustrating isolation from the government.

The problem is that the precinct captain no longer has anything important to do. He can't put any pressure on the driver's license bureau, because they're all civil service there. He can ask to get your pothole fixed, but they're civil service too. He doesn't have any jobs to hand out to your kid, and doesn't know anybody who does. And most importantly and worst, he can't deliver votes from his precinct on election day, because his voters watch TV and make up their minds based on issues he can't control, so the higher levels of politicians don't feel the need to pay too much attention to him.
In other words, the personal relationship in politics now runs directly from you to the President, directly from you to Congress, and directly from you to Springfield. Unfortunately, the signal-to-noise ratio falls off on those long lines: it's very hard to get an intelligible message through these days, and even harder to get a useful answer.

But take heart! If TV and radio technology got us into this mess, computer technology just may be able to get us out.

Suppose the precinct captain had access to a database, updated daily, of information about *how to work the government?* Suppose you could ask him for help about how to work the government, and get it? Would having that be worth supporting a particular party?

Remember, even in the old days, the precinct captain was not a miracle worker. Sometimes he could deliver on government services, and sometimes he couldn't. The most important benefit he delivered was to remove that terrible, teeth-grinding sense of being caught in an insensible machine. The precinct captain had enough personal contact with enough people in government that most citizens felt they had some control over the process.

So we need not wish to endow the precinct captain with superhuman powers to cut through bureaucratic red tape and obduracy. There are lots of points where control over the process of government can usefully be exerted. Here are some hypothetical examples:

- In any office, some people work more effectively than others and get more done. So if you need to ask for a zoning variation, try to talk to Miss Valdez. Don't give the form to Mr. Wernicke, he's just waiting out his retirement.
- Everybody has some hot buttons it's wise not to push. You might know, for example, not to approach Mrs. Hotchkins in the Assessor's office with a big friendly smile and your hand out, because she gets defensive about that. But if you're dealing with Mr. Fremovich in the same office, you must treat him like an old friend unless you want your paperwork to go to the bottom of the pile.
- There are often legitimately multiple ways to reach the same goal. If you want a pothole fixed, try calling the city's central complaint desk first. If they can't make a specific promise, it is quite legal and often effective to call the ward office directly.
- Politicians can still influence some offices. If you want to get your daughter transferred out of the Navy base she's in, Senator Jason can help. Don't call him, here's the name of the person who handles military requests in his office.

And so forth and so on. Suppose that a political party were to develop a database of information like this? Suppose it were a new party æ call them the "Poplicrats". If the Poplicrats had a precinct captain in every precinct or even most precincts, if people knew who the precinct captain was, and if people learned that a request to the Poplicrats got results even part of the time ...

... why, then the Poplicrats would take over America.
Now, can this be done? Actually, it can be done with near-current technology. The initial expense of setting up such a project would be very high (not for computers, but for data collection) but not more than we currently spend for a national political campaign. With a tool like this, the Poplicrats wouldn't *need* a lot of TV commercials.

The first element in the database is a "business model" of all government at all levels, all over America. This model reflects the official organization of each government organization. This is a huge task—I forget the exact number, but I've seen estimates that Cook County alone answers to something like two hundred and fifty separate government authorities (counting all the suburbs, Fire Departments, the sanitary district, flood control districts and so forth). Probably the best way to keep such a database updated is to assign each person in the Poplicrats to one little office, and have him or her visit the office once a month to ask who's working there now. Once we have that, we create a database entity called a "document path." Because virtually all government actions take the form of moving a document from one place

to another, we can define "jobs the government does" as a series of document paths, where a document path is a network of nodes and connectors with numerical weights assigned to the best paths from origination to completion. Each node is a person or office (not necessarily a government function) that handles the document and passes it to somebody else. The job of the Poplicrats, then, is to expedite the movement of the document along the optimum path.

For example, suppose a relative has just died, and you have a feeling somebody ought to turn off his social security payments. You call your Poplicrat precinct captain, and explain the problem. He stops by the house that evening with a paper like this (I'm making up all the details):

1) Call the Social Security administration at 708-987-7876, hours 9 am to 2:30 pm. It is best not to call at lunch. Ask for the Benefits Office, then ask for Mrs. Gloria Montez if she is available. If not, speak to "any benefits agent."
2) Tell her about the death of your Uncle Ralph. You will need:
   His full name:
   His Social Security Number:
   Date of death:
   County in which death occurred:
3) Tell her you want to establish a Termination of Benefits Record (Form 24-567) and a Change of Benefits (Deceased Recipient) (Form 34-890).
4) The Social Security Administration will inform the Veterans Administration for you. However, you must call the state Department of Veterans Affairs at 678-890-2356 (hours 9:30 am to 5:00 pm). Ask for the Benefits department and give them the same information.

At the same time, the precinct captain also has a few other sheets of instructions for other things to do relating to Uncle Ralph's death that you may not have known you needed to do, such as paying his real estate taxes.
Each document path is indexed by a list of questions for which this path is the answer, or tasks to be done for which this path is the solution. Each path is also indexed by keywords to allow the user to browse through a list of tasks.

Next, the database has an index of persons describing their relationships to other persons and personal characteristics that affect their job performance. It is utterly critical that this data is collected only with the full knowledge of the person affected, and that it contains only that information which the person himself has agreed to store. Moreover, any person's complete file must be instantly and politely available to him or her, and can be edited and corrected at any time.

Example: you, as a precinct captain, send Mr. Jones to the Water department to adjust his bill, and advise him to ask for Mrs. Gronski. An hour later, Mrs. Gronski is on the phone bellowing about the jerk you sent to her, and telling you to keep your no-account friends to yourself. You manage to get her calmed down, get her to agree to see applicants if they're polite, then add a notation to her file advising all applicants not to cop an attitude with Mrs. Gronski. You carefully tell Mrs. Gronski that you have done this.

Needless to say, although some precinct captains are going to know about civil servants who can be reached with bribery, this information must never appear in the database because it will be demanded in law cases regularly.

Finally, we come to a part that cannot be done with current technology, but might be possible by the next election. It's silly to expect ten thousand neighborhood Poplicrats to be entering and editing information in the database and maintain any kind of data integrity. It is also not feasible to expect the Poplicrats to maintain a large central staff to enter data. The solution must be an artificial intelligence on a central computer that can accept changes to this data orally, over the phone.
This isn't as hard as it sounds. It should be possible to codify all changes to the data as a series of a few dozen stock phrases. Voice recognition is good enough now to understand pre-defined phrases in discontinuous speech, and will soon be good enough to compensate for regional accents.

The data-input facility will not accept changes indiscriminately, but will give them more or less weight (expressed as a simple integer) according to the past performance of the particular precinct captain who calls in the change. For example, if one guy regularly calls in to bad-mouth every government functionary he deals with, his opinions are taken less seriously than someone with a more balanced view. The report that is delivered for any particular document path reflects the highest-weighted data at each stage.

And the result? Note that this system is actually pretty light on computers, but requires an enormous number of people-oriented people who are willing to talk to voters every evening, and keep the central computer updated. This data can't be easily stolen, because it will grow stale within days if not kept regularly refreshed by experiences from all over the country.

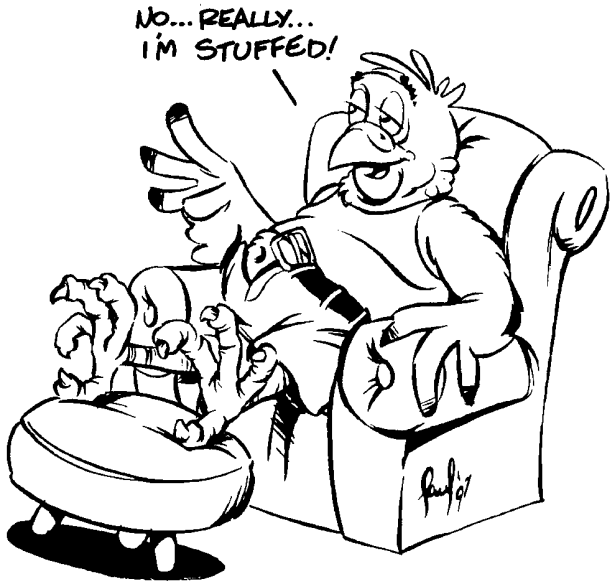
In other words, this method of taking over America can't be used by a small group of dedicated fanatics. It takes a large group of reasonably normal people working over a period of many years to develop the public's trust.
But if the Poplicrats, whoever they might be, were to make an investment in a system like this, they would not only win elections, but also restore the connection of confidence and performance between the American people and their governments, which seems almost hopelessly lost now.

At any rate, *I'd* vote for them.

ASK DR. TECHIE

Bill Higgins asks:
As we make plans for my wedding, my brother has asked if there's any documented evidence to support the widespread claim that throwing rice at weddings is bad for birds, because they eat it and swell up and explode or something. Is there anything to this, or is it just a canard?

Unfortunately, Dr. Techie's devotion to the scientific method has again backfired. He captured several pigeons for use as experimental subjects, but then discovered he had no rice in the house. Taking the birds around to the back of a Chinese restaurant he frequents, he asked the cook to let the birds stuff themselves with rice. Well, perhaps Dr. Techie's grasp of the reflexive in Chinese is weak, or maybe (as he insists) his Mandarin is perfect but the cook is Cantonese. In any case, when he returned, the birds were indeed stuffed with rice, but they were also covered in hoisin sauce and garnished with bamboo shoots. In the ensuing altercation Dr. Techie acquired what he calls a "chronic MSG headache," that recurs whenever birds and rice are mentioned. We therefore decided that the best man for this question was the best man at Bill's wedding, Dr. Barry Gehm:



Your brother's skepticism is well-warranted. I'm always disappointed when I see birdseed instead of rice being thrown at a wedding; I view it as a concession to a silly urban legend. Let me explain why.

For starters, I made a careful search of computerized databases of the biological and medical (including veterinary) literature, and found no reports of such a thing ever happening. In fact, if you search for papers relating to rice and birds, what you find are reports describing how much damage various kinds of birds do to rice crops, by consuming large amounts of the grain before it is harvested. Rice is a natural food for many kinds of birds. Ducks and geese rely on gleanings from rice paddies to fuel up for their northward migrations, and conservation groups encourage rice growers to deliberately leave a portion of their crop unharvested for waterfowl.

For these reasons alone, ornithologists and well-informed bird fanciers dismiss the whole notion of rice harming birds. The bird-lovers' newsgroup (rec.birds) Frequently Asked Questions list (http://usenet.umr.edu/faqs/birds-faq) says "We are aware of no documented cases of birds suffering from eating rice," and Steven Silbey of the Cornell Laboratory of Ornithology has written "Rice, even instant, is harmless; birds have powerful muscles and grit in their gizzards where foods are ground. Furthermore, rice expands only in boiling water; a bird's stomach is only about 105 degrees Fahrenheit, far below boiling point" (from the USA Rice Federation's Web page, http://www.usarice.com/tech/environ/conserv3.html).

Silbey is wrong on one point, though. As some believers in the legend point out, rice doesn't have to be boiled to cause it to swell. It will swell when simply soaked in water, albeit not as much and not as fast as when it's boiled. However, bear in mind that rice swells by *absorbing* water: the total volume of rice + water doesn't change when this happens. If you put 50 cubic centimeters of rice in a graduated cylinder which is then filled up with water to the 200 cc mark, and let it sit overnight, the rice will expand to about 100 cc, but the water level will still be at 200. (I may not be as determined an experimentalist as Dr. Techie, but I tried this.) There is no change in the total volume of the system. Thus, for a bird to explode from eating rice, it would have to drink so much water afterwards that it would explode even if the rice didn't swell. Not a very likely thing for a bird to do.

Moreover, there's nothing very unusual about rice's tendency to expand. All grains swell when cooked or soaked. In fact, *birdseed* expands on soaking just as much as rice does. I took a standard commercial birdseed mix that we use in our bird feeder and did the same overnight soaking experiment that I described above. Like rice, the birdseed expanded to about twice its original volume. Again, the total volume of grain + water didn't change. We don't see lots of exploded bird corpses around the feeder.

This raises the question of how the legend got started. I suspect it began when churches and other wedding venues were looking for an excuse not to allow rice-throwing because of the mess. Claiming it would inflict a horrible death on innocent little birdies was easier than telling people who were paying hundreds of bucks to rent the hall that the janitor couldn't be bothered to clean up afterwards. That backfired, of course, when somebody decided that tradition didn't demand rice *per se*, and started throwing birdseed. So we get messy churches and a silly urban legend besides. Some churches now ban throwing rice or birdseed because (they say) people can slip and fall on them. Be that as it may, the idea that throwing rice at weddings will result in avian explosions is strictly for the birds.

QUARKS

• The advent of mammalian cloning hasn't kept GTers from making little techies the old-fashioned way. Several new installments of "GT: The Next Generation" have been produced:

Michael Andrew Cruickshank Peed, born March 28, 1996 to Mary Cruickshank Peed and Andrew Peed.

Douglas John MacNerland, born April 9, 1996, to Linda Tangalan and Paul MacNerland.

Sabrina Fathom Stein, born June 10, 1996 to Diana Harlan Stein and David Stein.

Michael Corwin Trombly-Freytag, born August 8, 1996, to Kelley and Scot Trombly-Freytag.

Rebecca Lauren Oesterling, born August 28, 1996 to Cindy and Chris Oesterling.

Meara Elizabeth Pellar-Kosbar, born November 2, 1996 to Christine and Kyle Pellar-Kosbar.

"Buck" Farmer, born March 31 to Jennifer and Ken Farmer. (Ken says that until they can settle on a real name, they're calling the baby "Buck" because it's "sufficiently objectionable that we could use it without fear of permanence." We bet Anthony Rogers' parents said the same thing.)

Thomas Victor Ridley, born May 3 to Jenn and John Ridley.

Karina Jeanette Haas, born June 27 to Liz and Paul Haas.

Raymond Dwight Shouse Waterson born July 2 to Mary Kay and Rick Waterson

Aurora Elizabeth Lane, born July 15 to Joyce and Charles Lane.

Kevin Augustus Meida King, born August 26 to Roxanne Meida King and Steve King.

PYRO offers hearty congratulations to all the parents, and reminds them that every child deserves his or her own subscription.

• Congratulations are also in order to Tim Eisele and Sandy Hubscher, who were married in Ypsilanti, Michigan, on June 8, 1996. Rumors that the bouquet toss was done with a trebuchet have not been confirmed. And congratulations to Bruce Schneier and Karen Cooper, wed in Minneapolis on March 2, 1997. Bruce went on to make headlines a few weeks later as part of the team of cryptanalysts that broke a widely used encoding scheme for digital cell phones. Rumors that the bride and groom exchanged secret decoder rings during the wedding ceremony have also not been confirmed. (Rumors that a PYRO subscription makes a lovely wedding gift, however, *have* been confirmed).

• Of course, we can think of one couple that probably *doesn't* need a PYRO subscription: Bill Higgins and Kelley Mathews were married in Warrenville, Illinois, on August 23, in a ceremony attended by nearly the entire Chicago-area GT contingent. The reception featured possibly the largest Swiss-Army-Knife salute on record, a blinking blue-LED garter (created by Todd and Mary Lynn Johnson—see note below on "the blue unicorn"), a cake topper with figurines of the bride and groom (dolls customized by Jo Gehm) riding a rocket (Plexiglas sculpture by Tullio Proni), and the conversion of the couple's car into an aircar, with powered roof-mounted rotor blades, a tail fin, and a hood-mounted photon cannon (decorations by Rolf Wilson, whose imagination obviously goes well beyond tin cans tied to the bumper).

• As if the birth of two children to members of the PYRO staff and the wedding of one of our editors weren't enough to throw off our production schedule, Todd and Mary Lynn Skirvin Johnson were awakened in the night of July 16, 1996 by the sound of a torrential rainstorm and found that their house was being flooded. Aurora, Illinois, was inundated by 18 inches of rain in the space of 24 hours, setting a new record for the state and marking a 3rd most intense rain ever recorded in the US. The flood sent 16 inches of muddy water into the Johnsons' basement, which contained Todd's workshop, including his holography bench, and much of Mary Lynn's artworks and supplies. Fortunately the sound of the downpour woke them in time to rescue the most valuable and irreplaceable items from the rising waters. Cleaning up and repairing the damage were time-consuming, difficult and depressing, but when you have as many friends as Todd and Mary Lynn do, you don't face trouble alone. A large and deeply-appreciated turnout of volunteers helped make the recovery quicker, easier and less dispiriting than it looked to be at first.

• New developments in the "Quest for the Blue Unicorn" (Clyde. R. Jones description of his search for a blue LED back in issue #46): Mary Lynn Skirvin Johnson writes, "Ah kids, the blue unicorn has at last been found! ... I *finally* got mine in the mail and man, they sure are gorgeous! A rich, royal blue high power output LED. These have been unattainable since manufacturers have been scarfing up whole years' productions at a time, but at last, some have leaked out and it was worth the wait. Digikey has had them off and on and they are frequently backordered. They are gallium-halide, and are about $7.50 each. They are also very static sensitive (no I haven't blown one yet), so they need tender handling."

• We liked the laconic announcement Guy Wicker, e-mailed to his friends on October 25, 1996, which read simply, "I gave a presentation at the university this morning. Everyone liked it," and was signed "Dr. Guy Wicker." An attaboy to Wayne State University for unleashing an new electrical engineering Ph.D. into the world. We assume the examining committee never saw any footage of Guy's giant Styrofoam rockets exploding on the pad.

• Several other GTers have also recently earned the right to say "Trust me, I'm a doctor." Congratulations to Dr. Andy Anda (Ph.D., mathematics, U. of Minnesota), Dr. Gerald Corrigan (Ph.D., electrical engineering, North-

western University) and Dr. Kelley Mathews (Psy.D., Illinois Professional School of Psychology).

• Another of GT's distinguished science guys, astronomer Guy Consolmagno, Ph.D., S.J., recently returned from Antarctica where he participated in a meteorite-hunting expedition (similar to the one that recovered the meteorite that was the focus of the recent life-on-Mars controversy). During the expedition, Brother Guy planted a GT banner on an Antarctic glacier, thus establishing our claim to the continent. That ought to give us plenty of open space for Dr. Wicker's rocketry experiments!

Yes, around the country and around the world, GTers are hard at work pushing back the frontiers of smartness. Whether picking meteorites out of a glacier, or cell-phone numbers out of the air, General Technics scientists are there. With their help, Science Marches Onward! (Or, occasionally, breaks into a polka.)

A GTer AT THE VATICAN

Guy Consolmagno

A friend of mine likes to play Gregorian Chants in the lab. I thought of him one morning last summer, as the strains of a choir filled my computer room. The difference was, my music was live. Outside my window (and two floors below), the Pope was saying Mass for a group of visitors from Poland.

Since the early 1930's, the Vatican Observatory has been housed at Castel Gandolfo, the Pope's residence and working space during July and August. Sharing lab space, and living quarters, with His Holiness has both its ups and downs. We must have the best-protected meteorite collection in the world, though I still feel odd having Swiss Guards salute me when I walk into the Papal Palace. (I think they do it just to embarrass me. Some of them have gotten to be good friends; on their off-hours they'll come up to visit, and peek through our telescopes on clear evenings). And I feel somewhat self-conscious about working too late at night; I tend to pace the floor when I think, but the Pope's living quarters are, quite literally, right underneath my office. Yet seeing him out my window every day is an honor (albeit unnerving); and watching him, day after day, addressing crowds of people whose hopes and expectations he must bear has given me a profound sense of awe and respect, both for him and his impossible office.

Of course, most of the year, he is in the Vatican City proper. Here at Castel Gandolfo, in the Alban Hills an hour south of Rome, life is normally very quiet. We still follow the traditional Italian work schedule. Six days a week, the Jesuits start with 7 am Mass (in Italian; it's a wake-up call for me in more ways than one) and then proceed upstairs from our second-floor residence to the fifth-floor offices. My daily schedule, like everyone else's, starts with powering up the computer and checking my e-mail. Then it's on to answering letters, writing reviews, puzzling over data that make no more sense today than they did yesterday, chewing on that paper that needs just a little more work.

At ten, all work stops for *il caffé*. Our kitchen has an industrial-strength cappuccino machine, plus a staff of Italians who really know how to use it. By ten thirty it's back to work; for me, perhaps downstairs to the meteorite lab. An Italian nobleman donated his private collection to the Pope in 1935, the foundation of the 1100 samples we have today. Wherever we are, we finish work at 1:30 sharp. The lay staff of technicians head for home, while we Jesuits return to our quarters for a glorious *pranzo* (there is no such thing as a bad meal in Italy) and a several hour repose. By 6 pm, however, I'm usually back at work; and often it's midnight before I finally shut down the computer.

For such a small staff—only ten of us, half of whom are usually at our Tucson offices—we have outstanding facilities. Along with all the standard astronomical texts and journals, our library also has an extensive historical collection, including complete runs of journals like the Transactions of the Royal Philosophical Society (the first issues predate Isaac Newton). Our telescopes here are mostly teaching instruments nowadays; research observations are normally done at our new 1.8 m instrument in Arizona. But we have more than 2000 students tour the observatory here over the course of a year; and every two years we also play host to a summer school of twenty-five young graduate students from around the world. They liven up the place, spending a month of concentrated effort studying some aspect of astrophysics under the guide of both Vatican staff and visiting professors from Arizona, Cambridge, or Germany. (Our 1997 school covers Comets, Asteroids, and Meteors).

The solitude and peace of our setting promotes concentrated effort, and plenty of opportunity for reflection as well. It is a work environment well suited for the Jesuit ideal of "contemplation in action." Here as scientists we take literally the exhortation of our founder, St. Ignatius of Loyola, to find God in all things. Like Italian cooking...

Henry's Scary Stories of Spaceflight #3:

The Perils of Pioneer 11

Henry Spencer

By the time you are reading this, in 1997, Pioneer 11—over twenty years old and still limping slowly toward the stars—will finally fall silent. Its plutonium-heated power supplies have been steadily declining in output since they were made. In September 1995 the available power fell below that needed for continued scientific observations, and the spacecraft was officially retired. Sometime around now, power output will fall short of the minimum needed to operate the spacecraft itself... and the next time the Deep Space Network searches for Pioneer 11's signal, there will be only silence. Pioneer 11, possibly the luckiest spacecraft ever launched, will finally be dead.

Pioneers 10 and 11 were originally conceived in 1969 as small, simple spin-stabilized spacecraft for man's first venture into the outer solar system. Unusually for a planetary mission, the project was run by Ames Research Center rather than JPL; Ames had previous experience with operating small spin-stabilized deep-space missions (Pioneers 6-9), and there was some feeling that it was good for JPL to have competition. The specific primary mission was a Jupiter flyby. As was normal at the time, two spacecraft were built and launched for a single mission, against the possibility that one might fail.

The chances of failure seemed especially high for this particular mission. The Pioneers would be the first spacecraft to fly through the asteroid belt; there was no significant chance of hitting a large asteroid, but hitting a few hundred grains of sand would be almost as bad, and nobody knew how many small particles might lurk undetected in the belt. The Pioneers would be the first deep-space missions powered entirely by isotope generators—which had never been used for such lengthy missions—because sunlight would be dim and Jupiter's radiation belts could damage solar arrays badly. Providing maximum information about Jupiter's radiation environment was a major goal of the mission, and that meant penetrating as deeply as possible into the radiation belts, whose exact intensity was unknown and whose effects on the spacecraft electronics were a major worry. And finally, constraints on the cost and mass of the spacecraft made on-board computers impossible—in 1969, radiation-hardened computers were heavy and expensive—and so the Pioneers had to be controlled entirely from Earth, despite a round-trip communication delay that would exceed 90 minutes at Jupiter.

Pioneer 10 was launched in March 1972. Pioneer 11 followed in the next Jupiter launch window, in April 1973. Pioneer 11's primary mission was to be the backup for Pioneer 10: if Pioneer 10 failed before completing its Jupiter flyby, Pioneer 11 would repeat that flyby. If Pioneer 10 stayed healthy, something a little different could be done: if Pioneer 11 made a very close flyby of Jupiter, the resulting gravity assist would throw it into a trajectory that would rise high above the plane of the solar system and then come back down to encounter Saturn five years later. The planetary alignment wasn't very good—in fact, it could hardly have been worse (a good alignment, like Voyager 1's, gives a flight time from Jupiter to Saturn of only about 18 months)—but as a bonus to an already-successful Jupiter mission, it was irresistible.

Pioneer 11's perils started just after launch, when one of its RTG booms failed to extend properly. Frantic work at Ames and DSN managed to extend it.

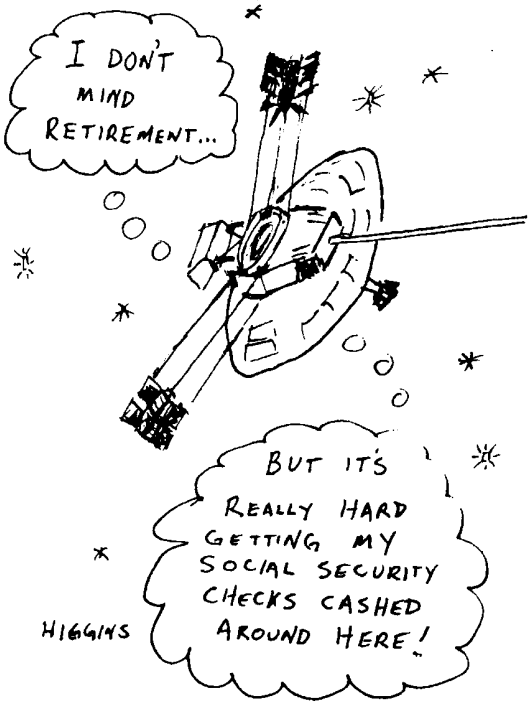
Both Pioneers survived the asteroid belt undamaged, despite early fears. In fact, they carried optical instruments to measure the density of small particles (by detecting light scattered from them as they passed the spacecraft), and the results indicated a density much lower than even the more optimistic predictions.

Jupiter's radiation belts, on the other hand, were every bit as strong as expected. As Pioneer 10 plunged deep into them (much deeper than the Voyagers later went), its radiation instruments came within a hairsbreadth of their upper limits. The 92-minute round-trip delays prevented any sort of real-time response to electronics problems, but precalculated command sequences were sent at appropriate times to reset crucial systems regularly. The spacecraft's electronic systems functioned rather erratically at times, but they never quit entirely. (Ironically, the one major data loss was the one item which might have anticipated some of the Voyagers' most startling discoveries: the Pioneers' only close-up image of Io was lost when Pioneer 10's imaging system acted up between reset commands.) Pioneer 10 emerged from the Jovian system battered and singed but intact, completing the Pioneers' primary mission.

Steering Pioneer 11 to Saturn did require a very close approach to Jupiter, about one-third the distance of Pioneer 10's closest approach. This seemed to require a frighteningly deep dive into the radiation belts, but it could be done well away from Jupiter's equator, where the belts are concentrated. The price was a very high radiation-intensity peak, although the total dose would be lower than Pioneer 10's. The bonus was a look at Jupiter's magnetosphere at high latitudes, probably the only one possible for many years, since the Voyager mission plans emphasized moon flybys and hence stayed farther out and near the equator. At closest encounter Pioneer 11 would be moving at nearly 50 km/s, still the all-time speed record for spacecraft.

In the end, Pioneer 11's experience at Jupiter was much like Pioneer 10's, with erratic electronic behavior but no permanent damage. The biggest problem with the Pioneer 11 Jupiter flyby, as it happened, was a strike by diesel-generator operators at DSN's Australian tracking station, which almost disrupted communications for six hours near closest approach! Pioneer 11 was on its way to Saturn, but it wasn't out of the woods yet.

For one thing, two of Pioneer 11's instruments malfunctioned en route. Not long after Jupiter encounter, occa-



sional spurious commands started to appear. Several months of detective work finally identified the problem as misbehaving circuits in one meteorite-detection instrument, which was turned off permanently. More seriously, during the detective work, various other instruments had been turned off temporarily... and the plasma analyzer evidently got too cold during its shutdown, because it refused to respond when commanded back on. This was a much more serious loss, but fortunately it wasn't permanent: although it took two and a half years of thought and experimenting, eventually the damaged circuits were tricked into responding, and the plasma analyzer was brought back into operation in time for the 1979 Saturn encounter.

While all this electronic troubleshooting was happening, a major debate was underway: where to aim Pioneer. For the Jupiter encounter there had been little choice, between the need to reach Saturn and the need to limit radiation exposure. Beyond Saturn there were no specific future plans, and indeed no specific need for the spacecraft to survive, so there were many options. Imaging of the moons was unimportant now, because the Voyagers—much bigger spacecraft with much better camera systems—had already swung past Jupiter and were en route to Saturn, less than two years behind Pioneer.

A number of trajectories were proposed, including one that involved flying through Cassini's Division in the rings. (It's just as well that option wasn't pursued, because we now know that Cassini's Division is not a gap in the rings, just a thin spot.) Gradually two major proposals emerged.

The more daring trajectory would take Pioneer *inside* the rings, with closest approach about halfway between the cloud tops and the innermost edge of the main rings. This was a relatively dangerous area, because there was known to be at least one faint ring inside the main ones. The estimated probability of spacecraft survival ranged from over 99% to under 1%, depending on whose ring-density model you believed. The payoff was a unique opportunity to observe Saturn and its magnetosphere close up, using an old spacecraft whose useful life was nearly over anyway. The problem was that actually losing the spacecraft at the ring-plane crossing would considerably reduce the data return. After long debate, the Principal Investigators who ran Pioneer's instruments voted 11-1 in favor of the "inside" mission.

The more conservative "outside" plan specified two ring-plane crossings, both well outside the visible rings. The chosen distances for the crossings matched the flyby distance needed for Voyager 2 if it was to reach Uranus... and the Voyager planners, given a unique and irreplaceable opportunity to visit two more planets, badly wanted to know if that distance presented any risks to *their* spacecraft. Such a flyby was also much safer for Pioneer, assuring Saturn data return after ring-plane crossing and also providing for a continued mission on into deep space.

The final decision was made at NASA Headquarters: using Pioneer as a pathfinder for the Voyager Uranus-Neptune mission was more important than getting maximum return from the Pioneer flyby alone. Pioneer would take the relatively safe "outside" trajectory. There was also considerable freedom to pick the exact time of the Saturn encounter, and *this* encounter would be timed so that the spacecraft would be in sight of two DSN stations during the most critical times.

In mid-morning on September 1, 1979, the Ames controllers tensed as Pioneer crossed Saturn's ring plane... and then gradually relaxed as the signal kept on coming in, indicating that Pioneer had survived. (Well, I oversimplify, since they were actually hearing about it 86 minutes after the real event... but that was Earth's view of the situation.) The busiest hour of the flyby—closest approach, below the rings—was underway and the spacecraft had survived.

And a few minutes later, safely past the ring plane, on the cautious, conservatively-planned "outside" trajectory, Pioneer 11 almost hit one of Saturn's moons.

Without warning, the outputs of several of Pioneer's

radiation detectors suddenly plunged to nearly zero, held roughly steady for eight seconds, and then snapped back up to their former values. For the same eight seconds, the magnetometer recorded major disturbances in Saturn's magnetic field. Pioneer had streaked through the magnetic "wake" of a moon roughly 200 km across, at a distance of no more than a few thousand kilometers—the closest it had come to any large object since leaving Earth.

Later, the villain was tentatively identified as a moon discovered the previous day from Pioneer's imaging, and suspected from earlier observations by Earth-based telescopes. After the Voyager flybys it became clear that there are two similarly-sized moons (now named Epimetheus and Janus) in the same orbit, and there is some uncertainty about just which one accounts for each earlier observation, including Pioneer's near-miss.

The remainder of the Saturn encounter, and indeed the remainder of Pioneer 11's life, was less eventful. It returned a lot of useful data from Saturn, although this was somewhat eclipsed by the far greater returns from the Voyager flybys that followed. After that, Pioneer 11 headed out into open space, slightly behind its older companion Pioneer 10 and the newer but faster Voyagers; in 1990 it left the solar system (by an admittedly-arbitrary definition). A slow trickle of data on the solar wind, the solar magnetic field, and cosmic rays continued to come back to Earth. A few years ago Pioneer 11 started having trouble pointing its antenna accurately at Earth, but otherwise its instruments and equipment are still in good shape. Only its power sources are fading.

There had been hope that Pioneer 11 might reach the heliopause—where the Sun's atmosphere and fields end and the galaxy's begin — before it died. By the chance of how the planetary encounters worked out, Pioneer 11 was heading out in the best direction, straight into the galactic wind. Alas, the heliopause is farther away than was once thought, and probably only the Voyagers will survive to reach it. (Pioneer 10 lasted until 1997, but it's heading out in about the worst direction, down the Sun's tail; the Voyagers will last 20-30 more years if nothing breaks.) After one of the most exciting lives ever led by a planetary probe, Pioneer 11 has died quietly in retirement.

VIDIOTIC RAMBLINGS CONTINUE ONLINE!

George Ewing WA8WTE/8

I am attempting to send this into Pyro/GT world headquarters on the alleged *Infobahn*. However, I do not have a real on-ramp here, and am attempting to make do by carving messages in a cyberpumpkin, and dropping the

ONE OF THE **LEAST** POPULAR TOYS OF THE CHRISTMAS 1996 SEASON: THE "TICKLE ME SAINT ELMO" DOLL

sucker off the nearest overpass into the bitstream when the weaselrats aren't looking! *[Editor's note: it worked.]*

Deep Reds Detected!

Deep Red is one of those low-budget SF movies that manage to get produced and apparently go right to the back shelf of a video store in Valdosta, Georgia, without any significant publicity or a theatrical release. I borrowed this from the collection of an SF fan in Florida who copied it off a cable channel late one night just for the heck of it, not knowing whether it was SF or a documentary on Soviet agents in the McCarthy years.

Deep Red is a semi-cyberpunk tough-guy private eye thriller, sort of a cross between Hal Clement's *Needle* and *The Maltese Falcon*. The McGuffin is not a black bird, but nanomedicaltechnologythingies of extraterrestrial origin. Good, tough, realistic acting by a bunch of unknown supporting actors, plus *Star Trek*'s John Delancie doing a fine job as a mad scientist/villain. A-, highly recommended.

...Nor any Drop to Drink...

Waterworld is now being released to the video stores, and everyone has already heard enough about how expensive it was, the Japanese Studio pirate gambit, etc. Just a few quick notes here. The bad guys are **much** more interesting than the alleged good guys. You gotta admire guys who smoke cigarettes, drink whiskey, are careless with firearms, row a supertanker to work each morning, and drive submersible jet skis with "Nuke The Whales" bumperstickers on the back. Except for a few neat gadgets on Costner's catamaran, the "good" guys are boring. C-

Heterodyne Boys in the Alps/Visit Washington! *High Frequency* is just another one of those Italian Swiss Spaghetti Ham Radio Espionage Thrillers that they've been cranking out... Handsome young techie lad, age 10, with gorgeous widowed mother lives on picturesque lighthouse, prowls the ham bands... makes friends with older techie working at big dish relay facility in Swiss Alps, together they witness video murder, do cooperative detective stuff, foil plot in Washington DC, save Free World from Cold War bad guys, etc. Actually, this is pretty well done, in a Rick Brant/Tom Swift/Jonny Quest sort of way. A few minor technical flubs for the sake of action and plot advancement, but remarkable because everyone in this movie, even the bad guys, is fairly intelligent, unlike many YA adventures we've all seen lately.. B+

GIST OF THE LIST

Andy Peed

Here am I, your intrepid GT-PFRC electronic mailing list reporter, with the inaugural selection of GT-PFRC list discussions that have seemed worthy of note. Before wading into the collection, I'll give you a rundown of the criteria I use when picking and choosing amongst all the traffic that goes across the GT-PFRC list. Generally, I try to stick to topics which are interesting and relatively unusual from a techie perspective. I stay away as much as possible from religious discussions, sociological discussions, and discussions of a technological nature that degenerate into quasi-religious discussions. [A generic example: "vi vs. emacs" editor warfare.] I also stay away from those topics which periodically recur on the GT-PFRC list. Examples of these are Exploding Whales, Why You Shouldn't Post Dave Barry Articles, Strapping JATO Engines to Chevy Novas, Urban Legends, etc.

So... I'm going to kick off this column with a concept which I found particularly nifty, since it was new to me. Bill Leininger and Joan Eslinger exchanged a couple messages about National Engineering Landmarks. This designation is handed out by the American Society of Civil Engineers; although I couldn't find any reference to it on the ASCE home page (http://www.asce.org/), it seems to be awarded to construction projects which employ innovative engineering techniques in an aesthetically pleasing manner. Some National Engineering Landmarks are:

- Going-to-the-Sun Road (US Highway 89), through Glacier National Park, MT. More information may be found on the Web at: http://www.motorists.com / states/mt.htm

- Fairmount Water Works, Philadelphia, PA. More information may be found on the Web at: http://design.coda.drexel.edu/students/acohen/WaterWorks.html.

- Ascutney Mill Dam, Windsor, VT. Built in 1834; one of the oldest and largest stone works in the US.

- Kinzua Viaduct Bridge, Kinzua Bridge State Park, Johnsonburg, PA. Built in 1882, it was the highest railroad bridge in the world at that time (301 feet). More information may be found on the Web at: http://www.parec.com/kinzstpk.htm

- Bidwell Bar Toll Bridge, Lake Oroville State Recreation Area, Oroville, CA. This bridge was the earliest suspension bridge on the West Coast.

There must be others, but there isn't any definitive list that I can find on the Web. Would any of you civil engineers out there be able to point us to others?

Holy airplane shadows, Batman! While flying out of Reno, Bob Witting noticed a bright spot on the ground following the path of the plane, where one would ordinarily expect to see a shadow. It turns out that this phenomenon is called *heiligenschein*. Barry Gehm tells us that this is a German term meaning, literally, "holy shine." The phenomenon occurs when something on the ground scatters sunlight back in the general direction of the sun. Because you are above the shadow point, you intercept some of this bright return light as you look down at where you expect the shadow to be. Steve Poling expanded upon this explanation to describe why the phenomenon sometimes completely replaces the shadow: If you're close to the ground, your shadow subtends an arc of quite a few degrees, completely obscuring the heiligenschein. As you climb to altitude, the shadow gradually subtends a smaller arc while the arc subtended by the heiligenschein remains constant. Bob did some further research and found that the phenomenon was first described in the 1600's by a man who saw a halo around his head while walking in a damp field. He (the man, not Bob) apparently thought it reflected positively on his holiness. A similar effect can be seen at night when light "from" the moon is reflected by dew covered trees, grass, and other vegetation. This effect is called *sylvanshine*. Make note of that for your next Techie Trivial Pursuit games, folks.

We techie types all have our favorite tools. One thing that falls into the category of tools which excited quite a bit of discussion on the mailing list was the lowly pen. It seems, however, that most GT pens-of-choice are neither lowly nor low-tech. Some particular favorite writing implements amongst our ranks are: Pilot pens (Rolling Ball and Razor Points); PaperMate fine points; Sharpies, in various colors; antique, or at least treasured and well-loved, Parker pens; Fisher Space pens; Uniball Onyx and Micro pens; Cross pens, and the Koh-i-noor pens. A

few folks expressed a preference for Scripto mechanical pencils, particularly for work where the capability to erase is important; however, at least one of the Scripto fans also stated a liking for eraseable-ink pens. In the face of all these high-tech writing implements, there were two or three lonely souls (myself included!) who favor the cheap, no frills Bic round stick pens... and surprisingly enough, a couple folks spoke up for the Bic four-color ballpoint as their preferred workhorse. Talk about diversity! One of the particularly enjoyable aspects of this discussion was matching of pens to personalities. There's probably a sociology thesis in there, somewhere.

[Editor's note: To subscribe to the GT-PFRC mailing list, send e-mail to majordomo@mystery.com. Requests are sent in the body of a message and look something like:

subscribe gt-pfrc

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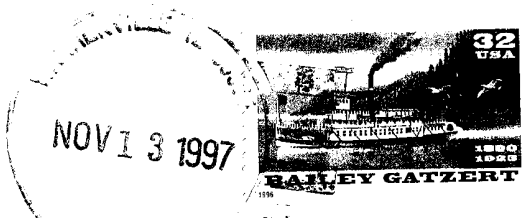

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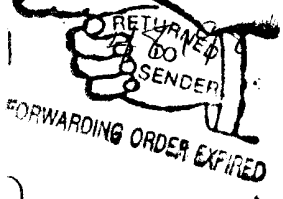
YPSILANTI, MI



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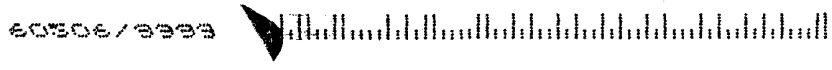
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